



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
-----------------	-------------	----------------------	---------------------	------------------

10/721,075 11/26/2003 Koichiro Tanaka 0756-7223 7829

31780 7590 01/12/2007
ERIC ROBINSON
PMB 955
21010 SOUTHBANK ST.
POTOMAC FALLS, VA 20165

EXAMINER

ELVE, MARIA ALEXANDRA

ART UNIT

PAPER NUMBER

1725

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
--	-----------	---------------

3 MONTHS

01/12/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary

Application No.

10/721,075

Applicant(s)

TANAKA, KOICHIRO

Examiner

M. Alexandra Elve

Art Unit

1725

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 October 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2,4-11,13-20,22-29,31-38,40-47 and 49-54 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,2,4-11,13-20,22-29,31-38,40-47 and 49-54 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 26 November 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

Claims 42-43 & 51-52 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The examiner has assumed for purposes of furthering prosecution that these claims are directed to a method for the manufacturing a semiconductor device.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-2, 4-11 & 13-18 are rejected under 35 U.S.C. 102(b) as being anticipated by Yamazaki et al. (USPN 6,700,096).

Yamazaki et al. ('096) discloses a laser apparatus for manufacturing a semiconductor device using laser irradiation. Two types of lasers may be used, these being, pulse oscillation and continuous oscillation. The semiconductor device has a semiconductor film formed on an insulating surface. The laser apparatus includes a plurality of laser oscillation apparatuses (102a-102d). The apparatuses may be based on one laser or on a plurality of lasers. Wavelengths may be the same or different.

Art Unit: 1725

Many types of lasers (pulsed and continuous) may be used, these include: an Ar laser, a Kr laser, YAG laser, a YVO₄ laser, a YLF laser, a YAlO₃ laser, a glass laser, a ruby laser, an alexandrite laser, a Ti:sapphire laser, and a Y₂O₃ laser. These lasers may be doped with Cr, Nd, Er, Ho, Ce, Co, Ti, Yb or Tm.

The fundamental wave of the laser differs depending on a material to be doped. An example is a laser light having a fundamental wave in the range of 1 μ m. It is possible to obtain a harmonic wave with respect to the fundamental wave using a nonlinear optical element. For crystallization of an amorphous semiconductor film it is preferable that the second harmonic through the fourth harmonic of a basic wave is applied. Typically, the second harmonic (with a λ of 532 nm) or the third harmonic (with a λ of 355 nm) of an Nd:YVO₄ laser (basic wave of 1064 nm) is applied. A gas laser or a solid-state laser of continuous or pulsed type oscillation may be used.

The laser beam spots may be shaped with an optical system into rectangular shapes, circular shapes, cylindrical shapes, ellipse shapes, slab shapes and so forth. The laser apparatus includes an optical system that is capable of having beam spots oscillated from respective laser oscillation apparatuses to overlap each other on the object to be processed. In addition, the laser apparatus CPU system controls the oscillation of the laser and the stage such that beam spots are corrected placed. Figures 34A-C shows a position control system. As shown in figure 3A the beam spots of respective laser beams are combined by matching the major axes of respective ellipses and also having the beam spots overlap each other, thereby forming one beam spot. The combined beam spots are irradiated onto a substrate that is being processed.

The center axis of the beam spot may be perpendicular to the scanning direction or at an angle of $45^\circ \pm 35^\circ$. Figures 5A-B and figures 11A-B show the differing angles that may be used during processing.

The focal distance and incident angle of each lens may be set to obtain desired processing results. The number of cylindrical lenses is not limited and the optical system used is not limited to cylindrical lenses. The optical system is capable of processing the laser beam spot of a laser light oscillated from each laser oscillation apparatus so that there is obtained a shape and energy density suited for the crystallization of a semiconductor film. In addition the optical system combines the beam spots of all laser beams into one beam spot by having the beam spots overlap each other. It is preferable that the laser beam incident angle θ satisfies the condition of $\theta \text{ arc tan } (W/2d)$ whereby W is related to the beam spot dimension (short side or long side) and d is thickness of the transmitting substrate. It is required that each laser beam satisfies this equation/condition before synthesizing.

In one embodiment the silicon nitride film formed using nitride gas is characterized in that there is an absorption peak of N-H association and Si-H association. Thus the apparatus has wavelengths that range in the absorption range.

It is further noted that the absorption coefficient is a property of the substrate and not a structural limitation of the apparatus. A recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention (the apparatus, not the workpiece) and the prior art in order to patentably distinguish the

Art Unit: 1725

claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 19-20, 22-29, 31-38 40-47 & 49-54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamazaki et al. ('096) as stated above and further in view of Yamazaki et al. (USPN 6,242,292) and Yamazaki (USPN 7,132,375).

Although Yamazaki et al. ('096) discloses absorption with respect to nitriding, absorption specifically with respect to a semiconductor material ($1 \times 10^4/\text{cm}$ or greater) is not taught.

Yamazaki et al. ('292) discloses that amorphous semiconductor material has a very different absorptance laser energy property than crystalline semiconductor material. In order to obtain a more uniform converted film, a two stage irradiation process is used, as follows: the amorphous portion remaining in the film is crystallized by a first irradiation process, and then the whole crystallization is promoted by a second irradiation process. By promoting the crystallization moderately, the nonuniformity of

Art Unit: 1725

stripes occurring on the semiconductor material due to the linear laser irradiation can be suppressed to some degree. Thus, the uniformity of the irradiation effect of the laser light can be remarkably improved and the stripes are made visually relatively inconspicuous.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a laser wavelength based on absorptance because this distinguishes between amorphous and crystalline and yields a more completely converted substrate.

Yamazaki et al. ('292) disclosed absorptance but not the specific values.

Yamazaki ('375) disclose that in the annealing and processing of silicon the absorption coefficient of the amorphous silicon is approximately 10^3 to $10^5/\text{cm}$.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use the absorption coefficient of approximately 10^3 to $10^5/\text{cm}$, as taught by Yamazaki ('375) in the Yamazaki et al. ('096) because most semiconductor devices use silicon as an initial substrate.

It is well settled that where patentability is predicted upon a change in a condition of prior art process, such as absorption coefficient ($1 \times 10^4/\text{cm}$ or greater), the change must be at least "critical", that is, it must lead to a new and unexpected result. Yamazaki ('375) absorption coefficient of approximately 10^3 to $10^5/\text{cm}$ encompasses the claim limitation of $1 \times 10^4/\text{cm}$ or greater. Thus applicant has the burden of providing proof of criticality. Note *In re Aller* et al. 105 USPQ 223. Absent proof of such criticality in the present instance, it would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the absorption coefficient as taught by Yamazaki

('375) into Yamazaki et al. ('096) process for the purpose of laser irradiating a semiconductor device.

Response to Arguments

Applicant's arguments with respect to claims have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to M. Alexandra Elve whose telephone number is 571-272-1173. The examiner can normally be reached on 6:30-3:00 Monday to Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick J. Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 1725

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

December 31, 2006.

A handwritten signature in black ink, appearing to read 'MAE', with a long horizontal line extending to the right.

M. Alexandra Elve
Primary Examiner 1725